WAVES (Water Vapor Validation Satellite/Sondes) Results from 2006 and 2007

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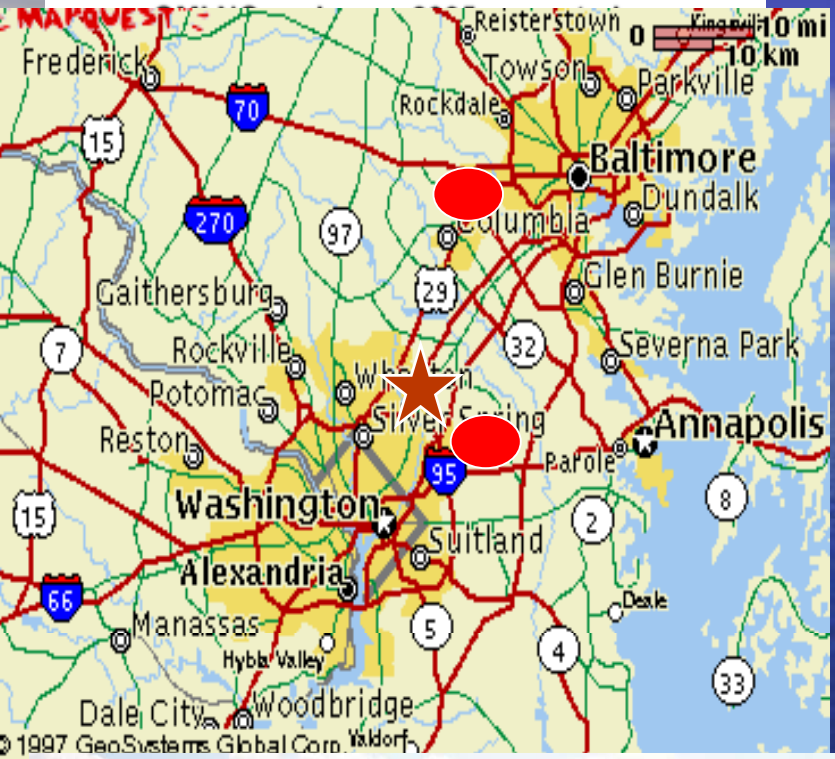
Howard University Research Campus - Beltsville



- A semi-urban field site
  - wide range of meteorological conditions
  - Environment very different than ARM sites
- "Difficult" retrieval site
  - heterogeneous terrain
  - summertime polluted conditions
- Good for validation case studies representative of polluted, urban conditions
  - how good are retrievals in the vicinity of the US capitol where millions of people live?
- Good location for inter-agency collaboration and education

NASA NOAA MDE HOWARD UNIVERSITY DEPARTMENT OF METEOROLOGY UMBC PENNSTATE

Beltsville Campus Instrumentation

Aerosol-Cloud-Radiation


RSS


MWR

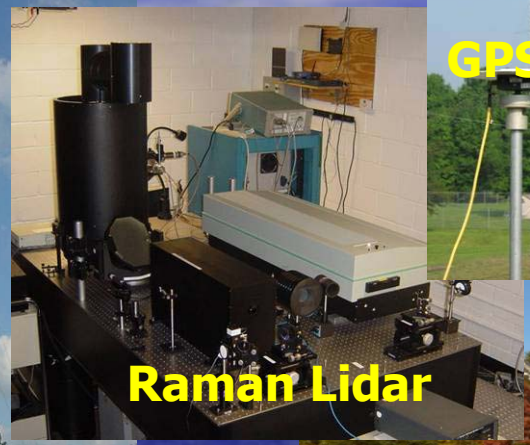

C25KT


Radiation


ALL-SKY

Atmosphere-Surface


31m tower
sfc moisture


Raman Lidar


GPS


FOX C-band
weather radar

Air Quality


Wind Profiler

MDE - Research quality
air monitoring

Integrating Research and Student Training


Ozonesonde launch


Lidar operations

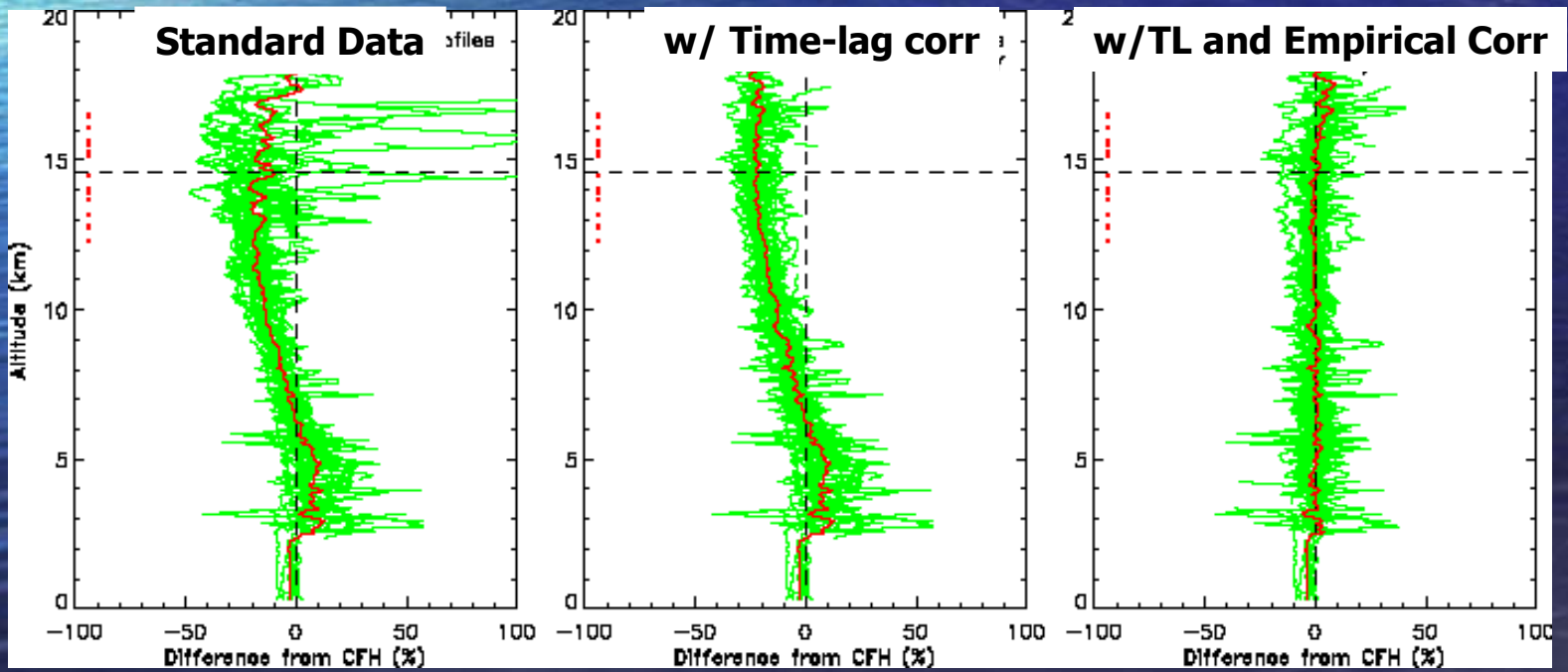
WAVES_2006 (June 27 – August 12, 2006)

- Accomplishments
  - ~35 A-train overpasses covered
    - 143 sondes including 15 CFHs, 35 ozonesondes and 7 technologies of PTU sensors (coordinated with overpasses)
      - Standard operational NWS technologies also tested
    - Coordinated operations with 7 lidar systems (5 Raman and 2 backscatter)
      - Water vapor, aerosols, temperature
  - 5 papers from JGR special section use WAVES data
    1. M. Shephard et. al., *Comparison of Tropospheric Emission Spectrometer (TES) Water Vapor Retrievals with In Situ Measurements*
    2. R. Herman et. al, *Validation of Tropospheric Emission Spectrometer Temperature Retrievals with Aircraft and Sondes*
    3. H. Vömel et. al., *Validation of Aura/MLS Water Vapor by Balloon Borne Cryogenic Frostpoint Hygrometer Measurements*
    4. R. Nassar et. al., *Validation of Tropospheric Emission Spectrometer (TES) Nadir Ozone Profiles Using Ozonesonde Measurements*
    5. B. Nardi et. al., *Initial Validation of Ozone Measurements from the High Resolution Dynamic Limb Sounder (HIRDLS)*

Radiosonde RH Analysis

- Calibrations change
  - Periodic validations useful
- Corrections from AWEX-G (2003)
- Expanded for WAVES
  - Vaisala radiosonde
    - Slow response at cold temperatures
    - Dry bias due to solar heating
    - Calibration errors

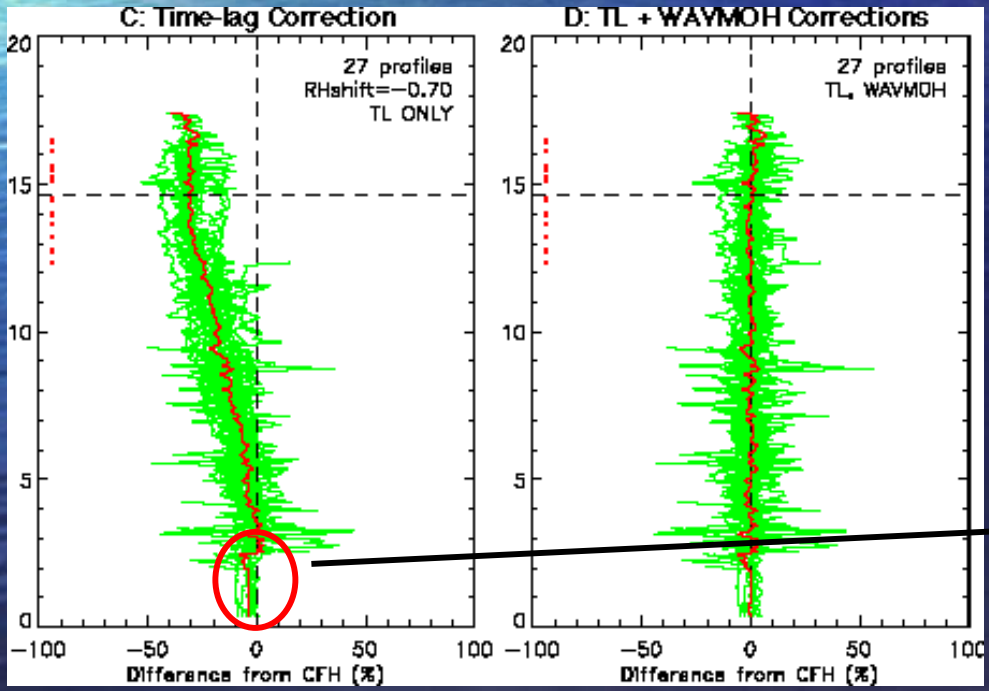
These errors are uncorrected in ARM-supplied data

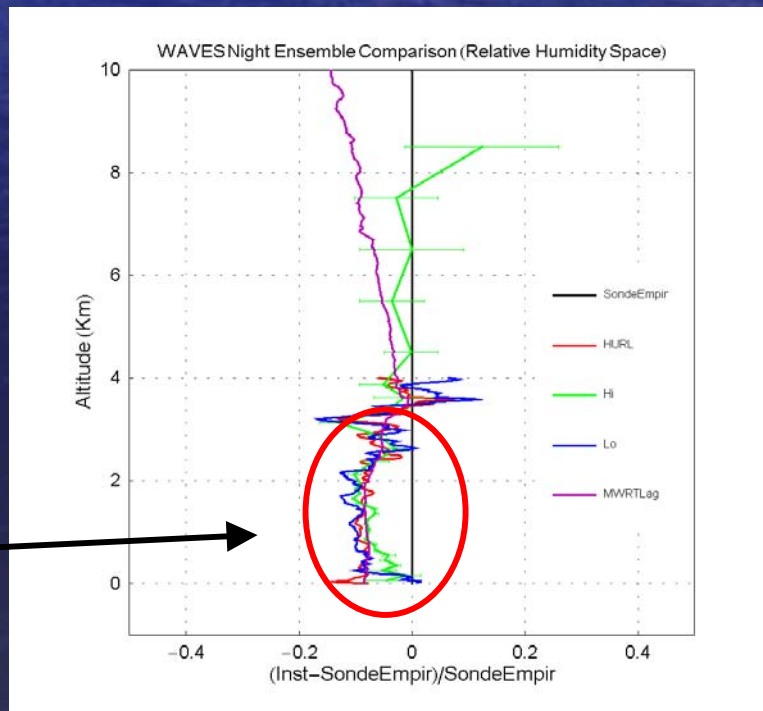


Miloshevich et. al., JGR (2006)
Whiteman et. al., JGR (2006)

WAVES Processing of Vaisala RS-92

- Attempts to follow the same procedure during WAVES_2006 revealed ~10% moist bias in CFH measurements in the lowest 3 km during the WAVES_2006 campaign.
- WAVES approach
  - Use the ensemble of available information for assessing sonde performance and implementing corrections
- Standardized sonde data format including corrections for ozone mixing ratio

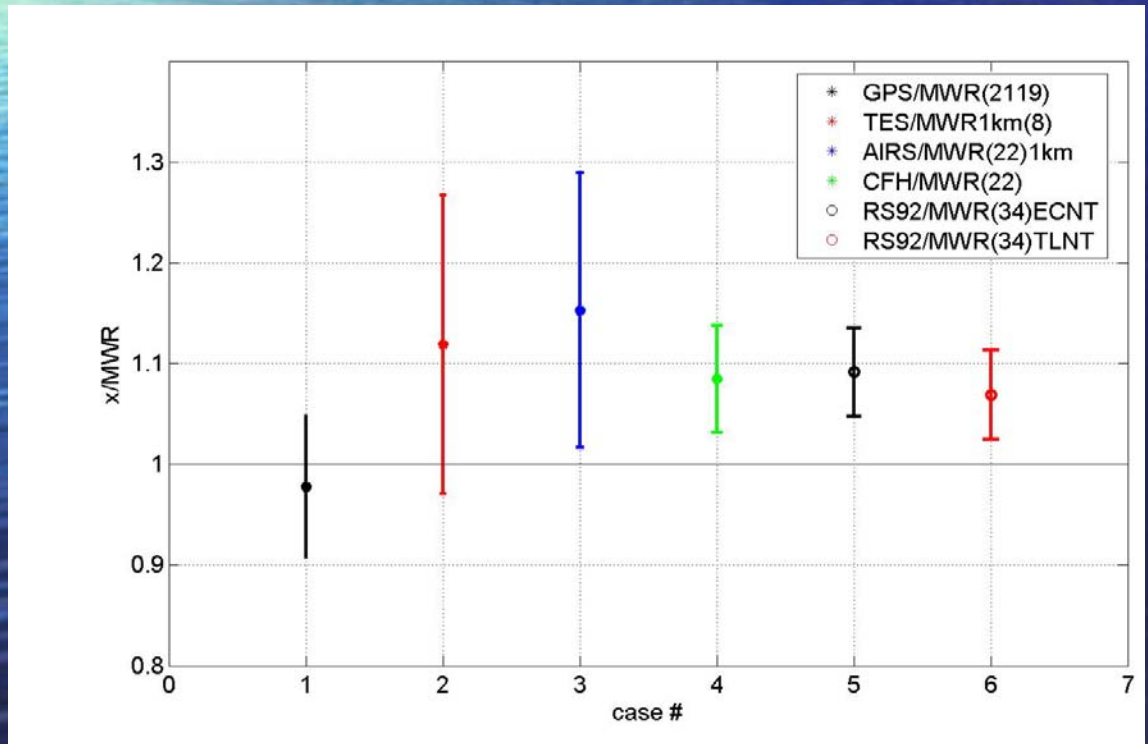


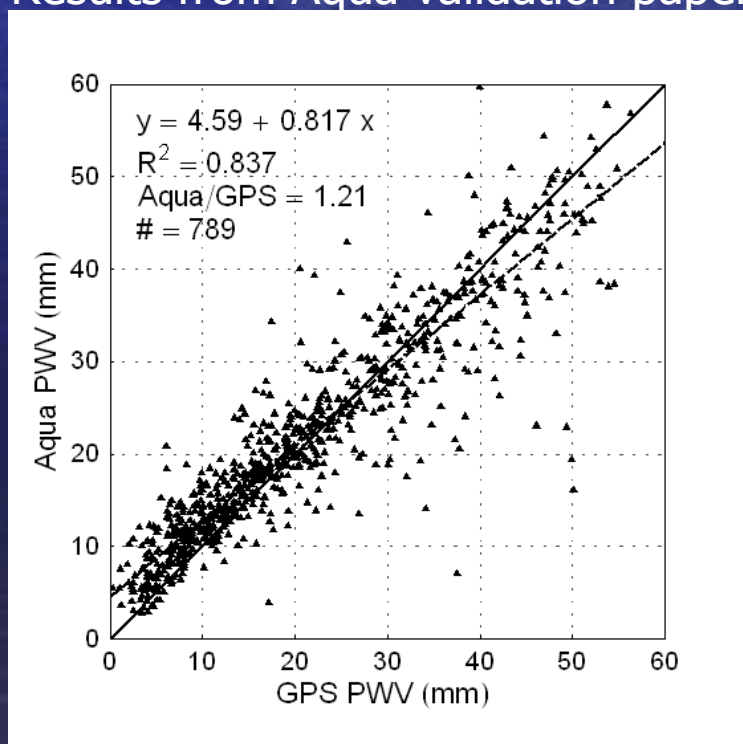


Water Vapor Total Column Comparisons

- One standard way to compare overall water vapor calibration is to compare precipitable water over a column set of altitudes/pressures
  - Permits comparison with the ARM "gold standard" – the microwave radiometer
    - Preliminary comparisons between BV and ARM MWRs show very good agreement
  - Previous such comparisons (AFWEX, AWEX) have achieved agreement at the ~5% level
- WAVES calibration comparison shows ~20% range of PW calibrations.
- AIRS and TES biased high with respect to MWR and GPS
  - Similar results to those reported in AIRS validation special section

Results from Aqua validation paper

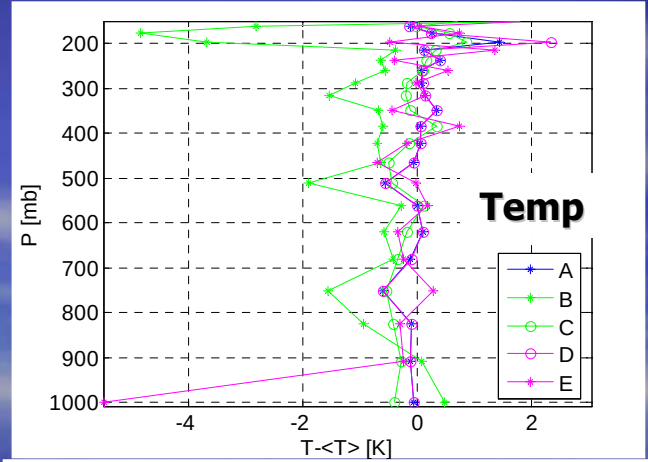


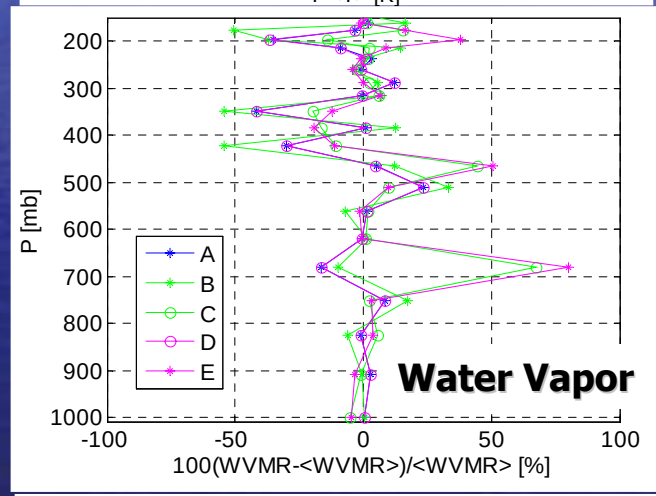


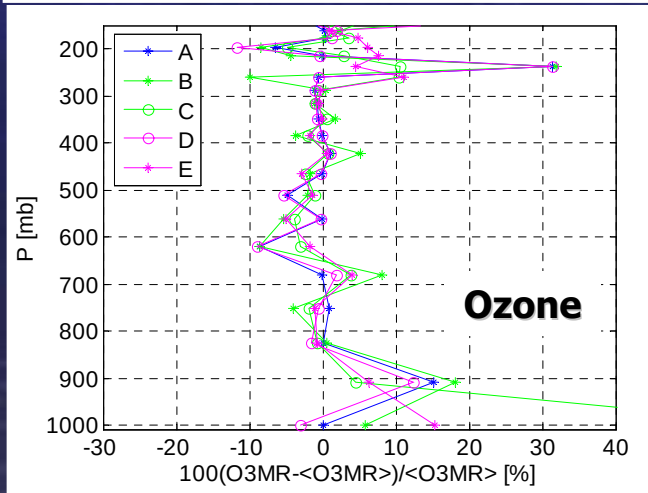
WAVES Intercomparison Study

GSFC, JPL, NOAA and Howard U.

- Focus first on step one: interpolation of sonde data to 67 level grid of TES
  - A blind comparison of 5 different methods revealed
    - Temperature: frequent differences of 1K and larger
    - Water Vapor Mixing Ratio: frequent differences exceeding 25%
    - Ozone: Agreement generally within +/- 10%

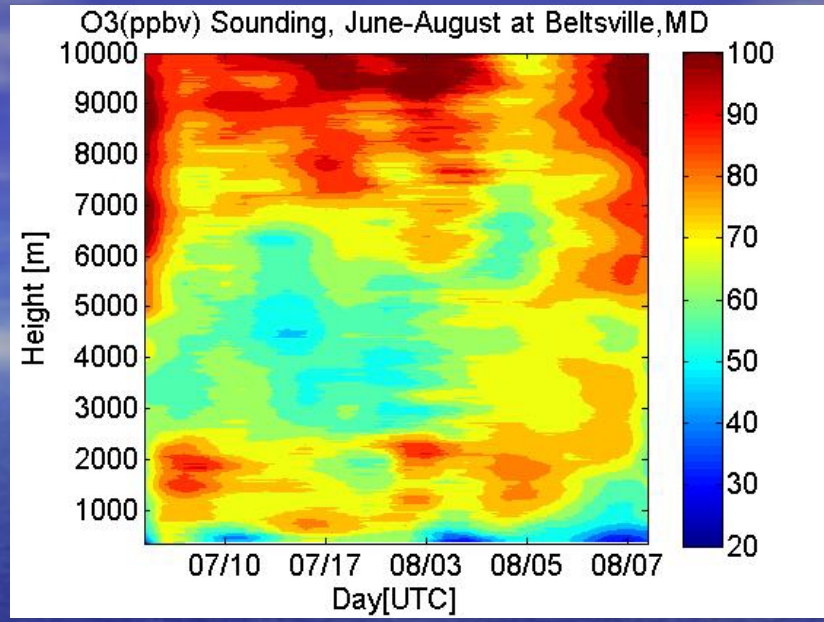






WAVES_2007

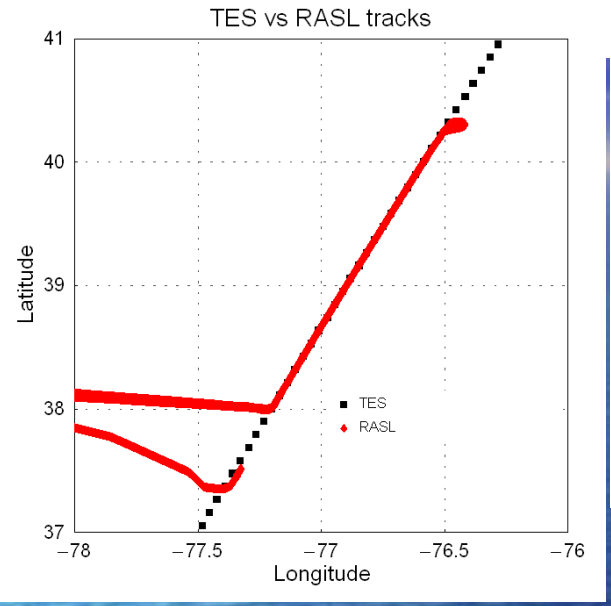
- July 14 – August 8, 2007
  - Fall/Winter component for sampling in different season
- ~20 A-train overpasses covered
  - Sondes: CFH – 15, RS92 - 78 (28 w/ECC), various lidars
  - 4 IASI overpasses covered
- Airborne component
  - Raman Airborne Spectroscopic Lidar (RASL) flying on KingAir
    - ESTO supported
    - Air to ground instrument intercomparisons
    - TES, CALIPSO underflights
    - Regional water vapor and aerosol variability



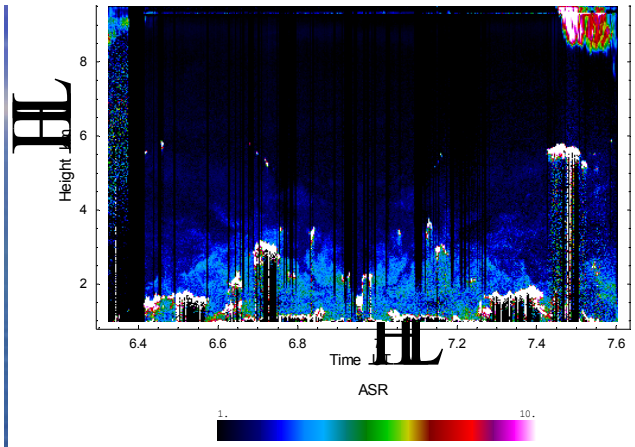
Summer 2007 preliminary ozonesonde time series at Beltsville, MD

RASL on a Dynamic Aviation King Air (Bridgewater, VA)

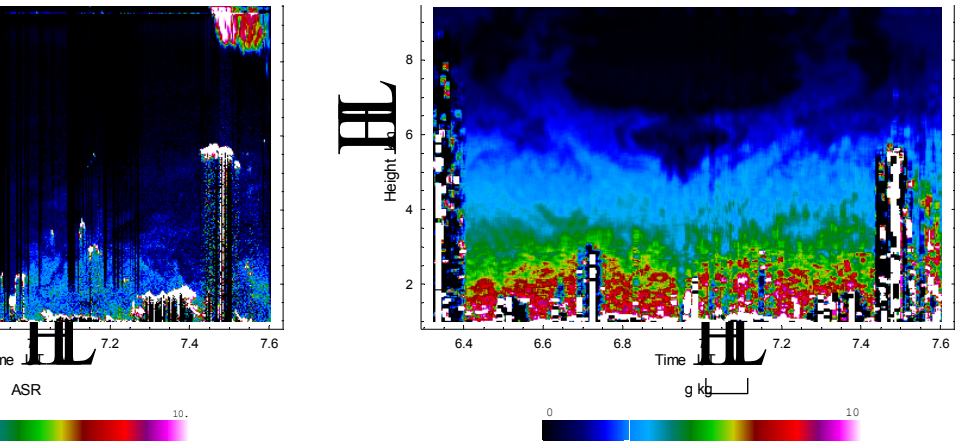
The Raman Airborne Spectroscopic Lidar (RASL) underflew TES transect on July 30



Cloud location & optical depth

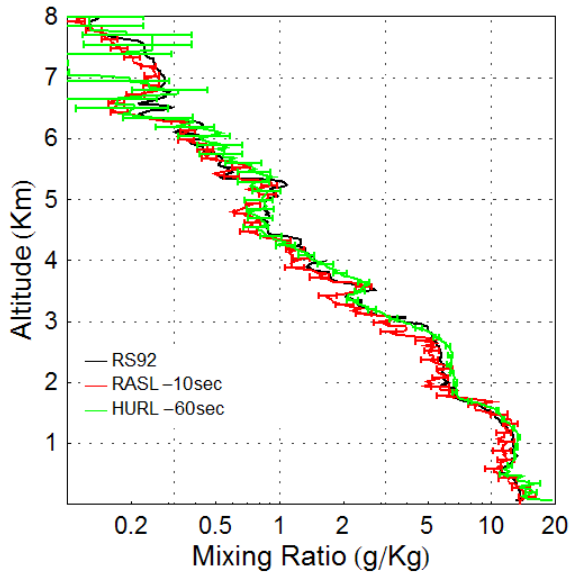


Water vapor mixing ratio



- 23 possible fov matchups
- RASL data being studied for fovs either clear or with low cloud amount

Aug 3 comparison of RASL, RS-92 and HURL



Questions?

Poster: "Lidar-Based Validation Activities during WAVES and MOHAVE"

Tour : JPL/TMF facility October 6. See Thierry LeBlanc.